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this country and offers a very fertile field for investigation.

Another phase of the origin of new forms is one which opens up a large field for research and ought to yield valuable results. This is the study of the changes in naturalized plants. In all the older parts of this country there are very many naturalized plants, principally weeds, which have been brought from abroad and are mostly of European origin. Many of these must have been introduced very early in the settlement of the country, so that some of them have been subjected to new environmental conditions for a period of nearly three hundred years. This ought in some cases to have resulted in perceptible changes, especially as these plants have not been subjected to the same keen struggle for existence which exists in their native habitat, and sometimes at least, grow in their new home with a vigor that one does not see in their native land. It seems to me that a careful study of some of these introduced weeds in their new environment and a comparison with the same species at home ought to furnish some valuable data in regard to some of the factors concerned in the origin of new species.

Finally, a critical study of variation in our native plants and the conditions associated with these should be of value in this same connection. In California, especially, the variations within the species are sometimes very marked and make the separation of species extremely difficult. While some of these variations can be explained by the difference in the conditions under which they grow, this is not always the case, and undoubtedly there are marked individual variations which can not be so explained. Such studies made upon plants in their natural surroundings should be more valuable than those based on plants growing under artificial conditions.

What then is the present outlook for botany in America? Facilities are certainly not wanting; equipment and aids to research are equal to those anywhere, and there surely is no lack of material and of problems awaiting the right men.

Are we going to attract to our profession men of such capacity that the next generation is to win results commensurate with the opportunities furnished by this rich and generous country? Let us hope that we shall soon become educated sufficiently to appreciate the labors of the scientist apart from their immediate pecuniary value, and that the men who are endeavoring to extend the boundaries of knowledge shall receive adequate recognition. When this is true, I think we may count on adding able recruits to our forces, and these botanists of a later day will be no mere adopters of ideas borrowed from foreign sources, but will be original investigators in the truest sense of the word. These men will appreciate the wealth of material lying immediately to hand and the important problems of American botany will receive full attention. Of course, I would not urge narrow provincialism in the choice of subjects—that is as far as possible from my thought—but I mean that the investigator should seek inspiration from the sources to which he has immediate access and not get it second hand, no matter how illustrious the source of inspiration may be.

Only by this reliance upon himself by the investigator can work of the highest kind be accomplished.

DOUGLAS H. CAMPBELL

*THE CARNEGIE INSTITUTION OF WASHINGTON*¹

NEARLY thirteen years have now elapsed since the foundation of the institution in

¹From the report of the president, Dr. R. S. Woodward, for the year ending October 31, 1914.

1902. A majority of the larger departments of research established under the direct auspices of the institution have been effectively at work for about a decade; while investigations of numerous individuals, primarily connected mostly with academic and other organizations, have been promoted for an approximately equal period of time. Thus, although this must be regarded as a very short interval in the career of an establishment whose history should be measured by centuries, it has been long enough to afford surprisingly large opportunities for the development of ideas and ideals concerning the conduct of research. In addition to the necessarily limited number of investigations actually undertaken by the institution, it has entertained proposals for research in nearly every imaginable field of abstract thought and of applied knowledge. If under these circumstances the institution has not learned something of the wisdom which is said to arise from experience, lack of abundance thereof can not be properly assigned as a reason for so obvious a lapse. An adequate account of this very extensive and very complex experience, which, while overloaded with the manifest and the impracticable, is yet rich in applicable instruction, may not be attempted here; an appropriate objective treatment would require a separate volume and another author. But it may be useful to contemporaries to set down here a few salient propositions, which, like those stated formally in my report for 1912, have been amply verified.

Thus, as regards research and the conditions favorable thereto, it is in evidence—

1. That it is inimical to progress to look upon research as akin to occultism and especially inimical to mistake able investigators for abnormal men. Successful research requires neither any peculiar conformity nor any peculiar deformity of mind. It requires, rather, peculiar normality and unusual patience and industry.

2. That fruitful research entails, in general, prolonged and arduous if not exhausting labor, for which all of the investigator's time is none too much. Little productive work in this line may be expected from those who are ab-

sorbingly preoccupied with other affairs. Herein, as well as in other vocations, it is difficult to serve two or more exacting masters.

3. That those most likely to produce important results in research are those who have already proved capacity for effectiveness therein and who are at the same time able to devote the bulk of their energies thereto. In general, men are not qualified for the responsibilities of research until they have completed independently and published several worthy investigations.

4. That research, like architecture and engineering, is increasingly effective in proportion as it is carefully planned and executed in accordance with definite programs. A characteristic defect of a large majority of the proposals for research submitted to the institution is a lack of tangible specifications. Estimates, especially of time and funds essential to carry out such proposals, are almost always too small. Those commonly made, even by skilled investigators, may be on the average safely doubled.

5. That, in spite of the most painstaking foresight, research tends to expand more rapidly and hence to demand a more rapid increase of resources than most other realms of endeavor. Its unexpected developments are often more important than its anticipated results and new lines of inquiry often become more urgent than those carefully prearranged for pursuit.

6. That it is much easier, in general, to do effective work of research in the older fields of inquiry than in the newer ones. It is especially difficult to enter those fields in which there is as yet no consensus of opinion concerning what may be investigated and what criteria may be followed. In some of the older fields, however, like the so-called humanities, for example, there is at present no such consensus of opinion, if one may judge from the large mass of expert but hopelessly conflicting testimony furnished to the institution by its correspondents. In such fields it appears now practicable to proceed only in a somewhat arbitrary fashion, accomplishing here and there good pieces of work regardless of divided opinions or even in opposition to expert

advice, in illustration of which may be cited the institution's publications of the "Old Yellow Book" and the "Arthurian Romances."

The larger departments of research of the institution are now so well established and so distinctive in their several fields that they might be regarded as so many separate organizations except for their dependence on the institution for financial support. They are not uncommonly considered, in fact, as independent organizations, while several of them have been mistaken for the institution as a whole. Such misapprehensions are inevitable, but their existence suggests a question well worthy of reflection, namely, whether it may not be well, in the course of time, for some, or all, of these departments to sever connections with the institution if they should have the good fortune to receive adequate separate endowments. The only concern the institution need have in such circumstances is that of securing to these departments the most favorable conditions for effective work. If this object may be best attained by independent foundations, or by affiliation with other organizations, no obstacle should be raised against such action.

But quite apart from these hypothetical considerations, the existing relations of these departments to one another and to the institution as a whole secure to them a degree of autonomy which could hardly be surpassed under other auspices. The liberties of action, thus designedly and freely conceded, imply corresponding responsibilities not only in departmental administration but also in departmental exposition, whether by summary annual reports or by elaborate monographs. Accordingly, and in conformity with other reasons referred to in previous reports, the following paragraphs aim to give brief indications only of departmental progress, reference being made for instructive details to the reports of the several directors in the current year book.

In connection with the subject of departmental researches particularly, the question is often asked "How can the 'practical results' attained be popularized and thus rendered available to the masses of mankind?" This is a question too large and too difficult for adequate discussion here, but it is one merit-

ing studious contemplation in the interests of our successors. It may be recalled that a hopeful paragraph was devoted to this topic in my first annual report, of 1905, but subsequent experience does not seem to justify the optimism entertained at that time. It is now plain, indeed, that while as a matter of fact truth is not only stranger but much more important than fiction, contemporary media for the dissemination of the sensational and the intangible are far more numerous and potent than the media for the dissemination of the demonstrable, and hence permanent, additions to knowledge. And it is equally plain that until there is an increased demand for less of the spectacular and for more of the real, both from journalists and from their readers, there can be little improvement in the popularization of discoveries and advances through such media. In the meantime, the increasing value of these researches, now everywhere recognized by scholars, may presently justify the engagement of an expert to popularize not simply the "practical results" but to furnish also what is in general more important, to wit, a clear and concise account of the principles and the methods by which such results are derived.

DEPARTMENT OF BOTANICAL RESEARCH

Although the greater part of the work of this department is carried on at its principal laboratory at Tucson, Arizona, it is essential to a comprehensive study of desert plant life to explore distant as well as adjacent arid regions. Thus, having published during the past year the results of an elaborate investigation of the region of the Salton Sea, the department is now, among many other activities, turning attention to similar desert basins, of which there are several in the western states that have been studied hitherto in their geological rather than botanical aspects. These researches are entailing also many applications of the allied physical sciences not heretofore invoked to any marked extent in aid of botanical science. Hence there results properly a diversity of work quite beyond the implications of botany in the earlier, but now quite too narrow, sense of the word.

In addition to the work carried on by members of the departmental staff, various investigations have been pursued by about twenty collaborators, several of whom have been in temporary residence at the Desert Laboratory. Among the more noteworthy publications emanating from the department during the year may be cited, along with the monograph on the Salton Sea referred to above, the instructive volume by Dr. Forrest Shreve, of the departmental staff, on "A Montane Rain-Forest" (Publication 199 of the institution). Favorable progress has been made by Messrs. Britton and Rose, research associates of the department, in their elaborate investigation of the distribution and relationships of the Cactaceæ. The facilities of the Desert Laboratory have been enlarged during the year by the completion and equipment of a specially designed small building for studies in phytochemistry, which has been proved to play a highly significant rôle in desert life.

DEPARTMENT OF ECONOMICS AND SOCIOLOGY

The work of this department has been confined in recent years to the preparation of divisional monographs, as explained in previous reports. Dr. Victor S. Clark, in charge of the division of manufactures, has been able to devote his time exclusively to this work and has been furnished office quarters for this purpose in the administration building at Washington. Other heads of divisions have been able to give half or less time to their divisional work, which is thus progressing somewhat more favorably than hitherto. It is hoped, therefore, that some of the monographs under way may be ready for publication during the coming year. Of the comprehensive "Index of Economic Material in the Documents of the States" projected by the department and prepared under the direction of Miss A. R. Hasse, the volume for New Jersey is now in press. Volumes of this index for eleven different states have already been issued.

DEPARTMENT OF EXPERIMENTAL EVOLUTION

The observational, statistical and physical methods applied by this department are constantly adding to the sum of facts and of in-

ductions essential to advances in biological knowledge. The range of application extends from the lowest organisms, like fungi, up to the highest, as typified in the race to which the investigators themselves belong. Thus, during the past year, observations and experiments have been made on mucors, plants, pigeons, poultry and seeds, while the director has continued his fruitful statistical studies in the relatively new field of departures from normality in mankind. The variety of agencies employed in this wide range of inquiry now includes a permanent staff of about twenty members and a physical equipment enlarged during the year by the completion of an additional laboratory and a power-house. Early in the year the facilities of the department were increased by the successful transfer, from Chicago to Cold Spring Harbor, of the remarkable collection of pedigreed pigeons recently acquired by the institution from the estate of Professor C. O. Whitman.

Among the numerous researches of the year to which attention is given in the departmental report, there may be cited, as of special interest, those of the director in human heredity, those of Dr. Blakeslee and Dr. Gortner on mucors, those of Dr. Riddle on the Whitman pigeons, those of Dr. Harris on the characteristics of seeds, and those in cytology by Mr. Metz. It is of particular interest to note that, in all of these, definite, measurable relations are anticipated as attainable, just as such relations are now assumed to be attainable in the older physical sciences. The director accepted an invitation from the New Zealand government and from the British Association for the Advancement of Science to take part in a series of scientific conferences held in Australasia during the past summer. Dr. Shull, of the departmental staff, spent the year in Berlin preparing his account of the horticultural work of Luther Burbank. The department expresses regret at the loss from its staff of Dr. R. A. Gortner, who has resigned to accept a position in the University of Minnesota. His abilities as an investigator and his capacity for effective cooperation won high regard from his colleagues.

GEOPHYSICAL LABORATORY

An instructive example of the favorable progress, which may be confidently expected in any field of research when entered by an adequately manned and equipped department devoted solely thereto, is afforded by the experience of the geophysical laboratory. In less than a decade this establishment has not only accomplished the formidable task of constructing the necessary apparatus and of preparing many of the pure minerals concerned, but has already begun the processes of analysis and synthesis which are leading to extensive additions to our knowledge of rock and mineral formations found in the earth's crust. In illustration of these processes the director's report cites the mineral system dependent on the elements lime, alumina and silica, which elements include in their multifarious possible combinations the well-known but hitherto little understood compound called Portland cement, whose properties have been determined as an incident to the general problem presented by this system.

Among the numerous problems under investigation at the laboratory, one of immediate economic as well as of great theoretical interest may be cited here by reason especially of the fact that funds for its execution have been supplied by industrial sources; this is the problem of the "secondary enrichment of copper ores," and the success attained in its treatment demonstrates the practicability of advantageous cooperation between the laboratory and industrial organizations without restriction to scientific procedure and publicity. The section of the director's report devoted to this subject should be of special interest to geologists and to mining engineers as well as to copper-mining industries. A more comprehensive idea of the productive activities of the laboratory may be gained by a glance at the section of the director's report in which he gives brief abstracts of the publications which have emanated from members of the staff during the year. These publications embrace forty-nine titles of papers which have appeared in current journals or are in

press, many of them having been published in German as well as in English.

DEPARTMENT OF HISTORICAL RESEARCH

The investigations of the department of historical research have proceeded effectively in accordance with the plans outlined by the director in his reports published in previous year books. In addition to the members of the permanent staff, several collaborators have taken part in these investigations, which have required explorations of historical archives in England, Scotland, France, Spain, Holland, Russia and Switzerland. Departmental plans for pursuit of peaceful studies in foreign archives, however, have suffered a serious check in the onset of the European war, and much work well started, or approaching completion, must now await developments from the pending conflict.

Two bulky volumes of guides to the sources of American history have issued from the department during the year as Publications 90A and 90B of the institution. These are, respectively, "Guide to the Materials for American History to 1783, in the Public Record Office of Great Britain," and "Guide to the Materials in London Archives for the History of the United States since 1783." It had been anticipated that a similar guide to the data on American history in the archives and libraries of Paris, in preparation under the charge of Mr. Leland of the departmental staff, would be completed before the end of the present calendar year; but the exigencies of the war have required the suspension of this work at Paris and the return of Mr. Leland to the departmental office in Washington. Similarly, work undertaken for the department in Holland by Professor William I. Hull and in Spain by Mr. Francis S. Philbrick had to be suspended. On the other hand, researches under way in Great Britain and in Russia have suffered little interruption. Work at the home office has proceeded without discontinuity. The director calls attention particularly to progress made in work on the projected "Atlas of the Historical Geography of the United States." Two divisions of this

atlas, illustrating respectively the history of presidential elections and the records of votes cast in the House of Representatives for or against certain typical measures of legislation, extending from 1789 to 1914, are already well advanced.

DEPARTMENT OF MARINE BIOLOGY

In accordance with plans recommended by the director of the department of marine biology and approved by the trustees in 1912, an expedition to Torres Straits, Australia, a region already known to be remarkable for abundance and variety of marine life, was undertaken in the latter part of the preceding fiscal year. Early in September, 1913, the director and six collaborators arrived at Thursday Island in the Straits, expecting to use this relatively accessible island as a base of explorations; but it was soon found advantageous to locate on Maër Island, one of the Murray group, about 120 miles east-northeast, and near to the outer limit of Great Barrier Reef. Here a temporary laboratory was set up in the local courthouse and jail, generously placed at Dr. Mayer's disposal by the British authorities. The region proved to be one rich in coral reefs and in marine fauna for the work contemplated. Observations and experiments securing gratifying results were carried out during the spring months (in the southern hemisphere) of September and October, 1913. In addition to the critical data secured by Dr. Mayer with respect to the corals about Maër Island, for comparison especially with corresponding data from the corals of Florida waters, observations and materials for important contributions to zoology were collected by each of his collaborators. One report, by Dr. H. L. Clark, is now in process of publication and is remarkable for the new species of echinoderms described and for the admirable drawings of these forms made from life by Mr. E. M. Grosse, of Sydney, Australia, who accompanied the expedition.

On returning to America from the southern hemisphere, the director was engaged, during April and May, in two minor expeditions with

the departmental vessel *Anton Dohrn*. The first of these was in aid of the researches of Dr. Paul Bartsch, on cerions, and required a cruise along the Florida Keys from Miami to Tortugas and return. The second expedition was in aid especially of Dr. T. W. Vaughan, long associated with the department in studies of corals and related deposits, and required a cruise from Miami, Florida, to the Bahamas and return. On June 9, 1914, work was resumed at the Tortugas Laboratory and continued until July 30. In all, fifteen collaborators during the year have availed themselves of the facilities afforded by the department. Brief accounts of their varied researches may be found in the director's report in the current year book, while detailed accounts may be expected in due time in the departmental contributions.

Attention is invited to an interesting section of the director's report devoted to a summary of the work accomplished by the department during the first decade of its existence. This section is instructive in showing that a decade is the smallest convenient unit of time for adequate estimation of the activities of such an establishment. It appears that during this decade 49 investigators have made use of the Tortugas laboratory, 28 of these having returned two or more times, making a total of 108 visits to this relatively inaccessible center of research. Of the publications emanating from the department, 60 have been published by the institution, while upwards of 40 have been published under other auspices; the institution has issued 2,551 printed pages and 269 plates exclusive of annual reports appearing in the year books.

DEPARTMENT OF MERIDIAN ASTROMETRY

The activities of the department of meridian astrometry are concentrated on the derivation of stellar positions for the comprehensive catalogue in preparation, on supplementary measurements of stellar coordinates with the meridian circle of the Dudley Observatory, and on investigations of residual stellar motions. The latter have now become the most important element in the definition

of stellar positions by reason of the extraordinary recent progress in sidereal astronomy, to which the department has contributed in large degree. Thus, along with the formidable computations required by the large mass of observations made by the department at San Luis, Argentina, researches are simultaneously continued on the problems of the star-drift, including the speed and direction of motion of our solar system. In the meantime, the catalogue is progressing favorably and some portions of the observatory list of miscellaneous stars are approaching completion, although cloudiness during the past two winters has interfered with this part of the departmental program. In the meantime, also, the manuscript of the zone catalogue of stars whose positions were measured at the observatory during the years 1896 to 1900 is undergoing the final process of comparison and checking preparatory to publication.

THE NUTRITION LABORATORY

The anticipations of a specially favorable environment, which were entertained when the nutrition laboratory was located in Boston near the Harvard Medical School and near several existing and projected hospitals, are now fully realized; and it would appear that the laboratory is reciprocally advantageous to the several establishments with which it is in immediate contact. Indeed, with this, as with all other departments of research founded by the institution, the only fears to be seriously entertained are those due to increasing capacity for usefulness and scientific progress, since such capacity tends quite properly to grow faster than the institution's income warrants.

The completion of adjacent buildings and streets has permitted bringing the grounds of the laboratory into harmony with its physical surroundings. Improvements have been made in the laboratory itself and several additions to equipment have been installed. These latter include new respiration apparatus for studies of metabolism in muscular work of men and of small animals, a reconstruction of an earlier form of bed calorimeter, and addi-

tional apparatus for photo-electric registration of physiological action in subjects under observation, whether near by or at a distance.

As indicated in previous reports, the laboratory and its work are subjects of international as well as national interest and many cooperative efforts are arising therefrom. Thus, Dr. Hans Murschhauser, of the Kinderklinik in Düsseldorf, and Dr. Carl Tigerstedt, of Helsingfors, have each spent several months at the laboratory during the year as research associates; while M. Lucien Bull, assistant director of the Institut Marey, in Paris, spent several weeks at the laboratory studying its apparatus and methods. The researches in progress by the laboratory staff are briefly summarized by the director under twenty different heads in his annual report, to which reference must be made for personal and technical details. Abstracts are given also in his report of the publications issued during the year or now in press. Of these, attention may be called particularly to "The Gaseous Metabolism of Infants with Special Reference to its Relation to Pulse-rate and Muscular Activity," by Francis G. Benedict and Fritz B. Talbot (Publication No. 201) and to "A Study of Prolonged Fasting," by Francis G. Benedict (in press as Publication No. 203).

DEPARTMENT OF TERRESTRIAL MAGNETISM

The extensive operations of the department of terrestrial magnetism on the oceans and in foreign countries have been adequately supplemented during the year by the new departmental laboratory, whose completion and occupation took place nearly simultaneously with the beginning of the second decade of the department's existence. This laboratory and its site provide greatly enlarged facilities for research as well as unsurpassed quarters for the resident departmental staff. This site (of 7.4 acres) is well protected on all sides from possible objectionable elements, while the laboratory is an exceptionally well-lighted, fire-proof building with 44 rooms and many specially designed adjuncts. Attention may be invited particularly to the relatively low

cost (22 cents per cubic foot) of this building, and to the reasons why it, like the geophysical laboratory and the nutrition laboratory, has been economically built. These reasons are found mainly in deliberate preparation of preliminary programs, in carefully drawn plans and specifications by competent architects, and in responsible superintendence of construction.

Near the end of the preceding fiscal year the non-magnetic ship *Carnegie* returned to New York City, where she underwent such extensive repairs as are always required by wooden vessels after long cruises in tropical waters. After refitting, she left New York, June 8, 1914, for a cruise in the North Atlantic. In this, the third of her expeditions, she traversed about 10,600 miles, making a first stop at Hammerfest, Norway, July 3, reaching the high latitude $79^{\circ} 52'$ off the northwest coast of Spitzbergen, touching at Reykjavik, Iceland, August 24, and returning to the base station at Greenport, Long Island, October 9, and to Brooklyn, New York, October 21. During this cruise the *Carnegie* was in command of Mr. J. P. Ault. She is now refitting for a longer cruise during 1915-1916, in southern latitudes (50° to 75°), where magnetic observations require supplementing.

An attempt at an ocean expedition into Hudson Bay was made under the charge of Mr. W. J. Peters during the past summer, but on account of unusual obstacles from ice this proved only partly successful. Entrance into the bay with the auxiliary schooner, *George B. Cluett*, chartered for this purpose from the Grenfell Association, was blocked until September 2, leaving less than a month's time available for surveys.

Determinations of magnetic elements on land have been continued in six parts of Africa, in as many states of South America, and in Australia, bringing the surveys of all these continental areas to a well-advanced stage.

Attention may be called to an interesting summary given by the director in his current report of work accomplished by the department during the past decade, as well as to accounts of the investigations now in progress

under the department at its laboratory, of the operations on land and sea, and of the departmental publications of the year. Of these latter, Volume II. of the "Researches of the Department of Terrestrial Magnetism," under the sub-title "Land Magnetic Observations, 1911 to 1913, and Reports on Special Researches," by L. A. Bauer and J. A. Fleming, is now in press.

THE SOLAR OBSERVATORY

With the end of the current year the Mount Wilson Solar Observatory, like most other departments of the institution, will have completed a first decade of its history. Quite appropriately, this establishment was founded at an epoch of maximum sun-spots, and a marked increase in solar activity during the past year furnishes similarly auspicious conditions for entrance into a second decade of research. But much more auspicious conditions are found in the extensive experience and in the effective equipment acquired along with the capital progress attained during this first decade. The most sanguine astronomer would have hesitated at the earlier epoch to predict that these latter conditions could be realized at the present epoch. Herein also is found a signal illustration of the superior effectiveness of establishments primarily designed for and exclusively devoted to research as compared with establishments in which research is a matter of secondary interest.

The work of the observatory for the year is much too extensive to permit of adequate summary here. But this is unnecessary, since the director's report, in addition to detailed accounts of observations, investigations and construction, gives a condensed abstract of the salient results arrived at. These results are briefly and clearly stated in 59 paragraphs. They refer to correspondingly numerous measurements, calculations and inductions made in studies of the sun and other stellar bodies whose characteristic properties are now stimulating extraordinary advances in cosmic physics.

Progress in construction of the 100-inch telescope has been made as rapidly as could be

expected in so formidable an undertaking. The delicate optical task of shaping the 100-inch mirror has been brought successfully by Mr. Ritchey to the stage of sphericity which precedes the final state of parabolization. The difficulties due to distortion of the mass of the disk, referred to in previous reports, have been overcome and other obstacles due to temperature inequalities in the optical room are likewise yielding to appropriate precautions. In the meantime the foundations for this telescope have been completed and the mounting and dome are expected to be ready for erection during the coming year. Several smaller parts and accessories for this instrument, requiring special exactness, are under construction at the shops of the observatory in Pasadena. Many additions and improvements in the apparatus already installed at the observatory have been made. The 60-foot tower telescope particularly, which was originally cheaply constructed in order to test the possible advantages of such a departure from earlier forms of telescopes, has been put in a state of efficiency comparable with that of the 150-foot tower telescope, leaving the latter free for the uses to which it is specially devoted. In these general improvements much attention has been given to rendering the plant on Mount Wilson more nearly fire-proof. The mountain road has been repaired, widened and strengthened in many parts in anticipation of the heavy traffic essential to transportation of the 100-inch telescope to its destination.

WORK OF RESEARCH ASSOCIATES AND COLLABORATORS

The variety and extent of the work carried on by research associates and collaborators has led to the widely spread but erroneous notion that the institution has entered, or is able to enter, all possible fields of investigation, and that an expert can be supplied offhand for immediate consideration of any question which the world may submit. But while such comprehensive capacity is obviously unattainable by finite means, or by any single establishment, the scope and ramifications of this work are such as to defy adequate condensation and

exposition within the limits of an administrative report. To understand this branch of the institution's activities one must at least read the titles of the reports and the publications which appear in the current year book and know something of the contributing authors and their environments. Summarily it may be stated that more than a hundred individuals have been engaged in these activities during the past year and that their work embraces a range of about thirty different subjects of research. Although attempts to draw lines of distinction between adjacent fields of advancing knowledge are alike futile and inimical to progress, it may be of interest to note with respect to these subjects that if they be classified under the two categories of descriptive sciences and mathematico-physical sciences, respectively, they will be found to be about evenly divided. It may be noted also that in this work the so-called "humanities" represent no small share, since researches have been promoted during the past year in Roman archeology, in Central American archeology, in Roman paleography, in history, in law, in linguistics and in several branches of literature. But in all this latter work the object has been not to fix, nor to accept, categories, nor to determine "shares," but to produce results of permanent value.

Referring to the individual reports and to the bibliographic lists in the current year book for accounts of the investigations and of the publications of the year in this highly diversified branch of the institution's work, it must suffice here to cite a few salient facts indicative of progress. Thus, Dr. Van Deman, in her studies of Roman archeology, has developed criteria for determining epochs and periods in the evolution of Roman construction, and hence in the evolution of Roman history. In the allied field of Roman paleography Dr. Loew has published, through the Clarendon Press, Oxford, a volume of researches under the title, "The Beneventan Script; A History of the South Italian Minuscule." The extensive researches in embryology carried on under the direction of Professor Mall, with the collaboration of a number of associates, have

proved highly productive, as shown by the publications issued and in press. Similarly, attention may be called to the fruitful studies of Dr. Osborne and Professor Mendel, which promise to throw important light on the intricate physico-chemical processes of animal nutrition and growth. The older sciences of chemistry and physics have made not less important progress through the contributions of a dozen associates and many more collaborators. A very noteworthy advance has been secured in meteorology by Professor Bjerknes through the international adoption of his methods and units for expressing meteorological data. Beginning with this calendar year and continuing up to the onset of the European war, the United States Weather Bureau issued daily weather maps of the whole northern hemisphere in conformity with these new methods and units, greatly to the advantage of theoretical and applied meteorology. The comprehensive and always highly suggestive expositions in geology and in cosmogony for which Professor Chamberlin has long been distinguished have stimulated his colleagues, Professors Michelson, Gale and Moulton, to the production of a capital contribution to geophysics in an ingenious and conclusive proof that the rigidity of the earth is about the same as that of steel. And finally, in illustration of the ease of passage from one field to another in this complex miscellany of independent researches, there may be cited the concordances of the earlier poet Horace and the later poet Spenser, now in press as numbers 202 and 189, respectively, of the institution's series of publications.

FINANCIAL RECORDS

The following list shows the departments of investigation to which the larger grants were made by the trustees at their last annual meeting and the amounts allotted from these grants by the executive committee during the year:

Department of Botanical Research.....	\$42,140
Department of Economics and Sociology.	5,000
Department of Experimental Evolution...	63,479
Geophysical Laboratory	85,500

Department of Historical Research	31,100
Department of Marine Biology	19,150
Department of Meridian Astrometry	25,180
Nutrition Laboratory	45,798
Division of Publications (office expenses).	10,000
Solar Observatory	220,892
Department of Terrestrial Magnetism	157,406
Researches in Embryology	26,900
Total	\$732,545

THE BUREAU OF MINES

IN his annual report to the secretary of the interior Director Joseph A. Holmes, of the United States Bureau of Mines, states that excellent progress has been made during the past fiscal year in the investigations of the explosibility of coal dust at the experimental mine near Bruceton, Pa. These investigations included a careful examination into the inflammability of coal dust collected from hundreds of mines in different coal fields and a systematic study of the possibility of coal-mine explosions starting from the improper use of explosives or the use of improper explosives, or from electric sparks, miners' lamps, mine fires, or other agencies.

Probably the most important feature of the year's work was the development of four types of explosion-stopping devices in which rock dust is used, as follows: Box barriers, concentrated barriers, ventilating-door barriers and ventilation-stopping barriers. The barriers were tested in strong and weak explosions and were effective in preventing propagation of flame beyond them. After being placed in a mine they are easily inspected and require little attention. Demonstrations before mining men led to inquiries from a number of companies, with a view to the erection of the devices in mines. The results of the tests at the experimental mines have shown the value of watering.

Four great explosions occurred during the year, as follows: One in the Stag Canyon mine, at Dawson, N. Mex., October 22, 1913, resulting in the death of 263 men; one at Acton, Ala., November 18, 1913, in which 24 men were killed; one at the Vulcan mine, New